At last concrete adhesives that are . . .

STRONGER THAN CONCRETE

ALWAYS REGARDED as a difficult material to repair, concrete now seems to be on the verge of shaking off this unfortunate reputation. The picture has changed primarily as a result of the development of a new family of adhesives with a forbidding name—epoxy-thiokol.

To date, they have been used with good results for the restoration of spalled and cracked surfaces of concrete bridges, buildings, and highways, and for such remarkable jobs as cementing traffic line center markers and raised traffic bars to highway surfaces. While cost considerations seem to rule out these adhesives as primary materials of construction, they appear to have almost unlimited possibilities in the field of restoration and repair.

Epoxy-thiokol adhesives have been the subject of both field and laboratory research in the materials laboratory of the California Division of Highways. In one investigation a number of 6- by 6- by 30-inch plain concrete beams were broken in flexure and then the two pieces of each beam were cemented together with an epoxy-thiokol adhesive. After curing for seven days at temperatures of 70 degrees F. or more, the cemented beams were again loaded to failure. In every case the new breaks occurred at points other than the original fractures. Obviously the bond of the adhesive was stronger than the concrete itself.

Another test by the same laboratory sought to establish whether the adhesive would be equally effective in bonding new concrete to old. Again 6- by 6- by 30-inch beams were broken in flexure, but this time one end of each broken section was coated with the adhesive and plastic concrete was cast against it. Then the beams consisting of approximately equal lengths of new and old concrete were thoroughly cured and rebroken. In every case the adhesive joint came through the test unbroken. The most careful examination of the specimens failed to disclose any shrinkage at the joints.

Field use of the adhesive by the California Division of Highways has yielded equally encouraging results. In

In a test conducted for the U. S. Army Corps of Engineers, a concrete beam was broken in flexure; then the two segments were cemented together with a proprietary epoxy-based alloy. Again subjected to a load test, the welded beam fractured at a new point, proving the weld was stronger than the beam itself.

Photo by courtesy of Permagile Corporation of America

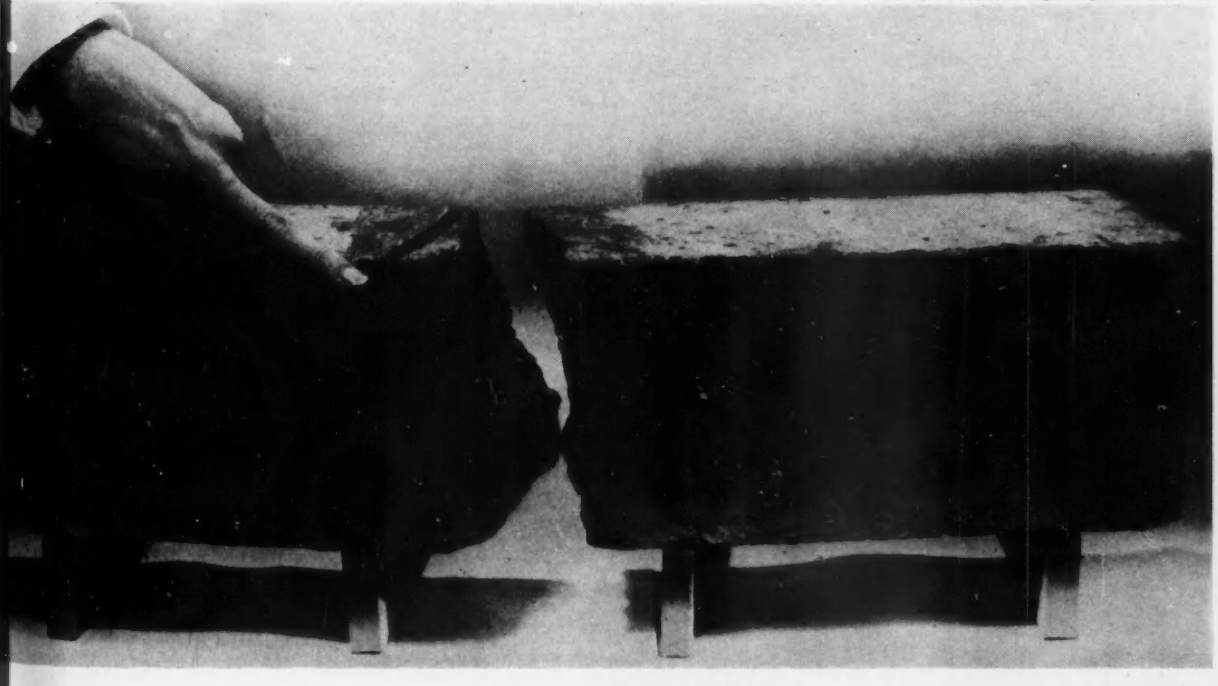


Photo by courtesy of California Highways and Public Works

A view of one of the patched areas on a section of abraded highway in Sacramento County, California. In this case the cavity was filled with a mixture of epoxy-thiokol and sand mortar. Note that there is no evidence that the repair material has shrunk away from the original concrete.

May, 1955, the department made repairs to a 200-foot section of concrete highway in Sacramento County. Cavities ranging from ½ inch to several inches in diameter, and from ¼ inch to about 2 inches deep were filled with a mortar consisting of epoxy-thiokol and sand. All the repaired spots were in excellent condition more than a year later, and even in the thinnest layers the mortar was found to have excellent adhesion to the concrete. Tests of the mortar indicated a compressive strength of approximately 900 psi.

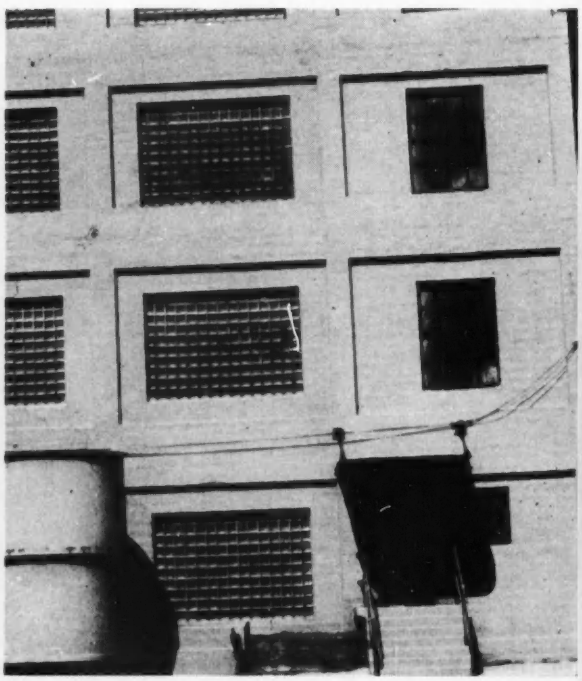
When properly cured, epoxy adhesives are also amazingly effective for grouting steel bolts in concrete. In laboratory tests the bolts fail in tension while the grout remains intact.

The adhesives used by the California Division of Highways were formulated in the division's own laboratory, using fillers and curing agents which would yield the best results in each application. The division's experience, reported in some detail in a recent issue of *California Highways and Public Works,* indicates that it is of the utmost importance that surfaces to be repaired be cleaned of oil and dirt by wire brushing or sandblasting.

The report stresses that the epoxy-thiokol adhesives are by no means foolproof. When properly formulated and applied, however, there can be little doubt that this new family of repair materials can win an important place in the field of concrete construction. You'll be hearing more about them.

END

These unretouched photos show before and after views of a concrete building that was restored with a commercial epoxy-based compound.



This view, which also appears on the cover of the issue, shows 1½- to 2-inch slump lightweight concrete being placed in a slab for a 6-story hospital in Jacksonville, Florida.

Let's take a look at . . .

Expanded Shale Concrete

LIGHTWEIGHT STRUCTURAL ready-mixed concrete had an opportunity to redemonstrate its versatility in the recent construction of a 6 story hospital in Jacksonville, Florida. Weight reduction without sacrifice of strength was an important consideration because the design of the structure called for the use of the lift-slab technique, in which the major part of the forming and casting are done on the ground.

An expanded shale aggregate was chosen in order to meet the specification requirement of 3,000 psi with the desired weight reduction. The strength requirement was actually met in just 7 days, instead of 28 days as required by the specifications. Thus it was possible to lift the slabs within a

Two 7-cubic-yard ready-mix trucks of the Capitol Concrete Company, Jacksonville, Florida, discharge simultaneously into a crane bucket.

week after the concrete was placed, providing the owners with a completed structure some weeks ahead of schedule.

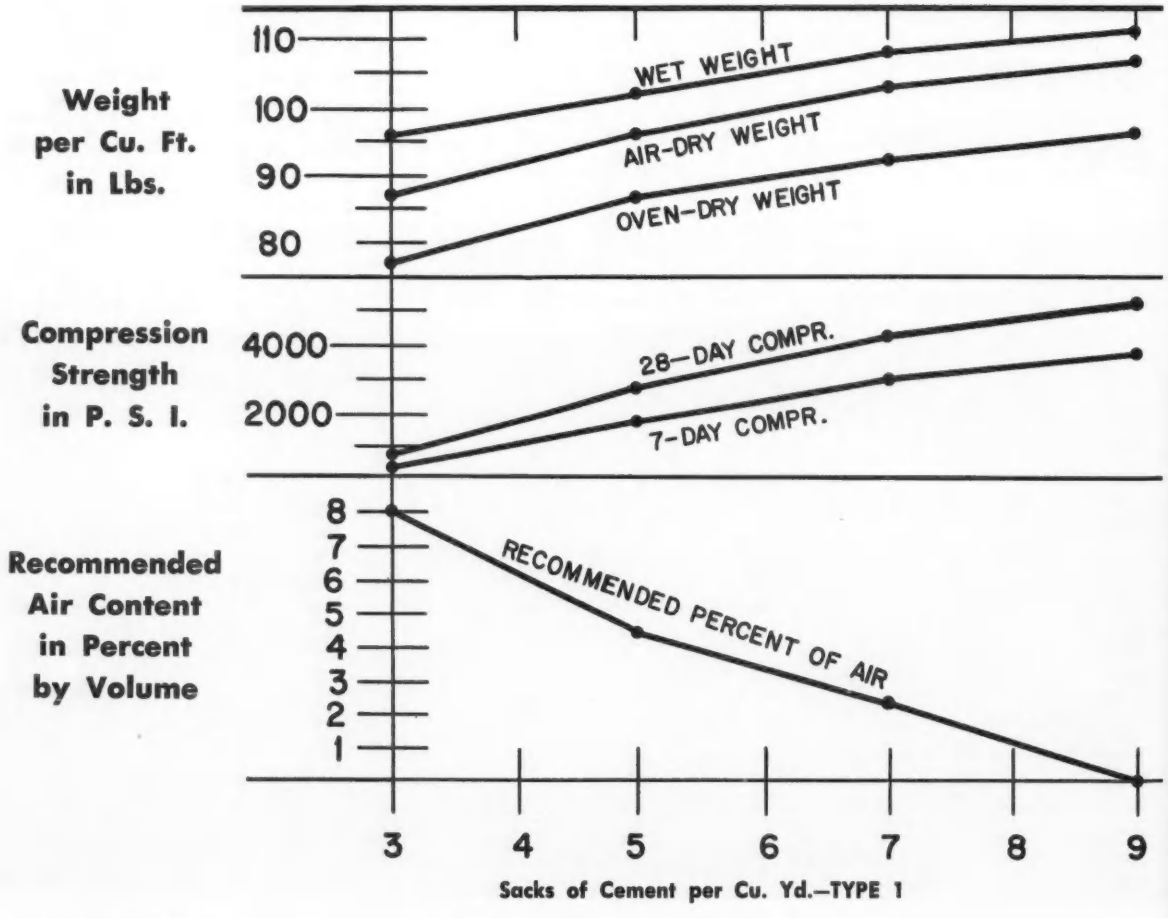
Concrete was supplied by Capitol Concrete Company of Jacksonville, using expanded shale aggregate manufactured by Georgia Lightweight Aggregate Company of Atlanta. The larger slabs on the project required approximately 210 cubic yards of concrete each. They were poured in about 5 hours to achieve a placement rate of 42 cubic yards per hour. As one of the accompanying pictures shows, a very low water-cement ratio was maintained, resulting in slumps ranging from 1½ to 2 inches. Despite these low slumps the builder reports that the material was satisfactorily plastic and had excellent finishing characteristics.

Lightweight concrete is, of course, by no means a new material. Interest in the whole question of reducing the weight of structures came about early in the present century as a direct result of the increasing use of structural concrete and steel. Designers were gradually weaned away from the practice of carrying loads on heavy load-bearing walls as the advantages of frame construction became more widely recognized. Long-span bridges and towering skyscrapers owe their very existence to the framework concept of design and the development of lightweight structural materials.

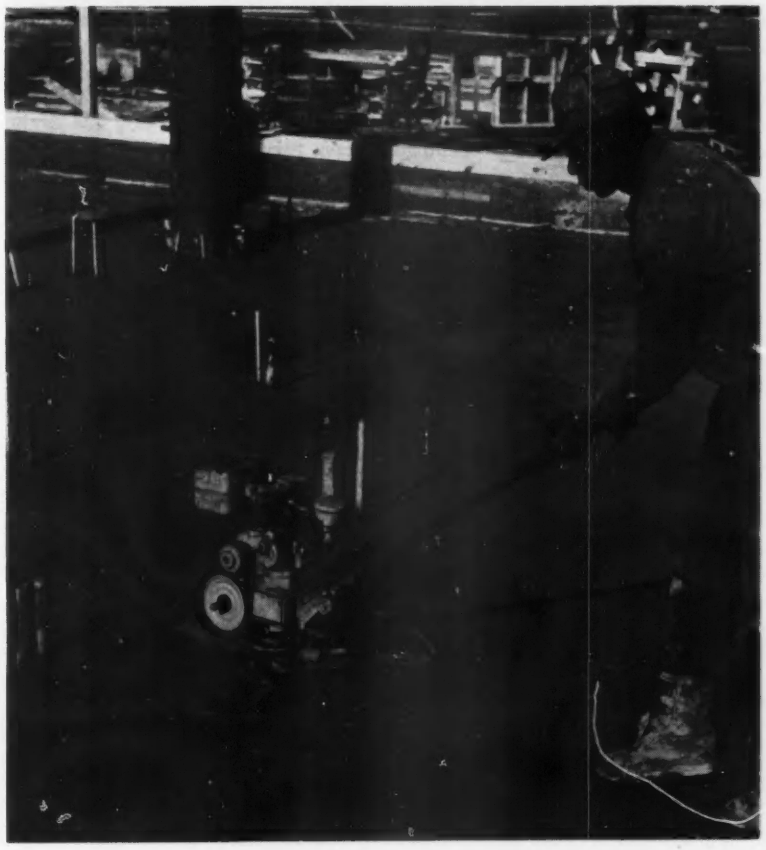
The first lightweight concrete was probably produced in the United States around 1890, using slag for aggregate, and coal cinders came into use early in this century. Probably the most important development was the introduction around 1920 of a manufactured lightweight aggregate called Haydite. This excellent structural aggregate consisted of clays, shales and slates which were bloated at high temperature in rotary kilns very similar to those used in the manufacture of portland cement.

Now widely marketed under many brand names, these expanded shales and clays have given construction men

These graphs show some average relationships between weights, strengths, and recommended percentages of entrained air for concretes containing expanded shale, clay, and slate aggregates. They were presented at a recent meeting of the American Concrete Institute by an official of the Georgia Lightweight Aggregate Company, suppliers of the aggregates used in the Jacksonville hospital job.



Workmen on the Jacksonville hospital job were especially aware of the excellent finishing qualities of the lightweight concrete—despite slump in the range of 1½ to 2 inches. The upper picture shows the finishers hand floating the main-floor slab after screeding, while the lower view shows one of the men applying the final finish with a gasoline-powered rotary trowel.



high-grade aggregates ranging in weight from 40 to 60 pounds per cubic foot. When properly used they produce dry concretes weighing from 90 to 100 pounds per cubic foot, as compared with 140 to 150 pounds per cubic foot for concretes made with most natural aggregates.

Most important of all, these expanded materials make it possible to reduce weight without sacrificing strength. This is accomplished by using only slightly richer mixes than would be required to obtain comparable strengths with sand and gravel or crushed stone aggregates. Normally the additional cement requirement is not over ½ to 1 bag per cubic yard of concrete. The use of entrained air in lightweight concrete mixes helps to prevent segregation and improves the workability of the material.

As might be expected, lightweight structural concrete generally costs more than heavyweight concrete. In many applications, however, the additional cost is more than absorbed by reductions in the amounts of concrete and steel required to support dead loads. This saving shows up not only in the above grade structural members, but also in the amounts of concrete and steel required for foundations.

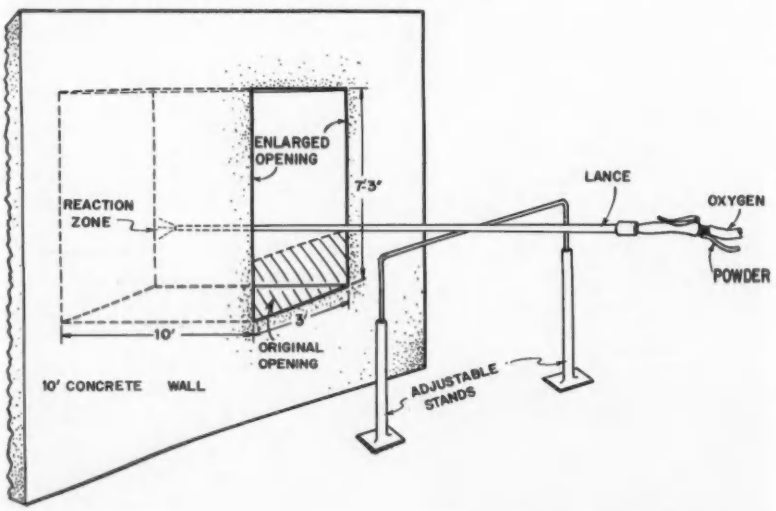
Lightweight concretes are also well worth considering for work in which the insulating and acoustical properties of the materials are important. They also have excellent fireproofing characteristics, and for this reason they are used on many jobs as covering for structural steel beams and columns.

By focussing the attention of architects and engineers on the tremendous versatility of concrete as a whole, lightweight concrete has unquestionably broadened the market for all types of concrete. You won't have calls for it every day, but you'll be more and more aware of it in the years ahead. END

Melt Concrete to Solve Difficult Cutting Problem

FACED RECENTLY with a concrete cutting problem of formidable proportions, the Bowser-Morner Testing Laboratories of Dayton, Ohio, resorted to a technique that involved actually melting away the concrete. The project called for enlarging a small opening in a 10-foot thick reinforced concrete wall to produce a smooth walled rectangular hole measuring 3 feet wide by 7 feet 3 inches in height. (See sketch.) Percussion and rotary core drilling were considered as possible solutions, but were found to be too costly and time-consuming due to the heavy reinforcing which it would be necessary to cut and to the horizontal tool position required.

Sketch showing how the block of concrete pictured at the top of the page was cut free from an existing reinforced concrete wall.



In the powder lance process which was finally employed, aluminum and iron powder are burned in contact with pure oxygen to produce an extremely high combustion temperature of around 6000 degrees F. This high-temperature combustion was used to literally melt both the concrete and the reinforcement bars, the molten material being forced out of the cutting slot by the velocity of the flame.

A powder lance consisting of a 21-foot length of ½-inch black-iron pipe was used to feed the mixture to the working face. The aluminum and iron powder mixture was fed through this lance under pressure of nitrogen to the point where it was brought in contact with the oxygen. Since the lance pipe was gradually consumed as the burning progressed, it was replaced from time to time. The complete job required approximately 250 man-hours.

Bowser-Morner's experience seems to indicate that the powder lance process may be applicable to many concrete cutting problems. In this case over-all costs were reduced, considerable time was saved, and a better end result was obtained than would have been possible if conventional methods had been employed. END

As a communication, maintenance,

and safety aid on construction jobs . . .

RADIO COMES TO THE RESCUE

IT'S ABOUT 4 P.M. one chilly afternoon in April. You just finished the floor of a new building when the temperature suddenly drops about 10 degrees. Too cold for the freshly poured concrete. The tarpaulins and salamanders you didn't think you'd need are now vital to protect the new floor. Here is where *radio comes to the rescue.* You get into your car, radio a trailer truck a couple of miles away, and tell him to rush the tarpaulins and heaters to the job site. Without radio, that new floor might be ruined!

In emergencies like the one above, a two-way radio system can be of invaluable aid. As a means of communication on the job site, it can save time and avoid errors and guesswork. Last-minute instructions and changes from the office can be reported to your men. In case of an accident, it can save a life.

How Does It Work?

You can have a two-way radio system that will cover distances from only a few hundred feet up to 120 miles. The system consists of a base station, mobile units for equipment, transmitter-receiver units and antenna installations.

The first thing you do before buying a system is apply to the Federal Communication Commission for a frequency. Allow about three months for it to come through. With this problem cleared, you are ready to make your purchase.

Most contractors have found that a 60-watt transmitter for a two-way radio serves them best. You can operate mobile units from either a 6- or 12-v system. It's a good idea to add an extra generator and battery to the mobile unit or install a higher output generator in the car or truck.

All sorts of conveniences have been

A radio-dispatched ready-mix truck of Clemente Brothers, Inc., Troy, New York, delivers concrete to a multi-million dollar shopping center job. The truck owner credits radio dispatching with having made it possible to meet commitments when a fire destroyed a portion of his fleet not long ago.

Photo by courtesy of General Electric

devised under a two-way radio system. You can be on call and, at the same time, supervise production in the field. You don't even have to be in your car to receive a call. You can have it so rigged that the horn will blow automatically when a call comes through.

Your men can receive instructions without climbing down from their trucks or bull-dozers. A portable loudspeaker with extension wiring can be clamped on the side of field equipment. Facing in the direction of the driver, it can transmit on-the-spot instructions or changes.

Radio can be carried where equipment can't. For men exploring the terrain of a job site, you can get a small hand-portable system, which weighs about 20 pounds. It has a range of 10 miles and can be carried in a knapsack across the shoulders—the way the infantry used radio in World War II.

Who Makes Them?

Two-way radio systems are manufactured by many outfits, but the big three are Motorola, General Electric and RCA. They will also service the equipment for a flat monthly maintenance fee. If you don't want to buy a system, they will work out a lease arrangement.

How Much?

The price will depend on how much power you want in your transmitter and how many mobile units you use. Shop around, in any event, for prices on both equipment and installation are competitive.

Just to give you a rough idea:
base station....from $750 to $2500
mobile units.....around $550 each
remote control station
.....around $200
transmitter-receiver units
.....from $600 to $1800 each
antenna installations
.....from $100 to $1000

What Can It Do For You?

With proper maintenance, this equipment should serve you from 7 to 10 years. The prices quoted may represent a sizable investment for you, so you will want to know what kind of return you can expect.

Radio aids in speedy repair of equipment. When there's a breakdown, the repair shop can be notified to start work immediately. And a substitute piece of equipment can be rushed to fill the gap. Very little job time is lost.

Radio aids in scheduling and coordinating the different operations of a job. Superintendent, foremen, and office can get together via radio at the end of a day to report progress and plan the next day's work. They save themselves travel time and avoid the delay of conferences.

Radio saves production time in getting instructions to men faster and in making faster shifts of men and machinery from one location to another. Some jobs are spread out over several miles. With two-way radio, men working anywhere on the site can be contacted quickly and directly.

Radio helps bring in new business because it gives the contractor a direct line to his office all the while he's out in the field.

Radio is a great safety device on a construction job. When a worker is hurt, an ambulance can be called to the scene immediately. It can mean the difference between a minor injury and a catastrophe. It may even save his life.

Above all—radio keeps costs down by speeding up production, bringing needed materials to the job site in a hurry, opening up communication on problems that might otherwise lead to costly errors, and reducing downtime when machinery is being repaired.

A significant number of ready-mixed-concrete producers throughout the United States are already using two-way radio as a means of conserving the time of their big truck mixers. Without exception they report that the investment in equipment has been returned promptly through increased efficiency all along the line. Since they cope with many of the same problems in handling an essentially perishable material, it seems almost certain that concrete contractors would realize much the same benefit.

A Case History

A recent convert to two-way radio communication is the ready-mix firm of Clemente Brothers, Inc., of Troy, New York. This company and the supplier of the radio equipment have worked out a system of three standard check-in calls for their drivers to use after leaving the batching plant.

When the truck arrives at the scene of a construction project, the driver checks in with a signal "1," preceded by the number of his truck. For example: Truck No. 15 would call in "15-1" to let the dispatcher know that the delivery is being made on schedule.

When Driver No. 15 leaves the construction site, he calls in with a "15-2," and when he is a block away from the batch plant, he gives a signal "15-3."

Two-way radio communication enables supervisory personnel to cover more ground more effectively.

Photo by courtesy of Radio Corporation of America

For routine day-to-day activity, these three calls provide the information the batch plant needs to provide faster service to the contractor and to fight the time and terrain problems which face every ready-mix producer working at new construction locations.

"We at the plant can visually tell when the driver is leaving our batching plant," Frank Clemente points out. "What we *want* to know is whether he has arrived at the customer's job safely and that he hasn't encountered any mechanical trouble on the way. This is taken care of by the first code number. The second one tells us whether the unloading process at the scene has taken the normal amount of time." In Clemente's operation perhaps the most important of all three calls is the third one, given by the driver when he is a block away from the plant itself. When this signal is

received, it is repeated by intercom from the Clemente dispatching office to the batch bin, just across the street. By the time the driver pulls into the yard, production personnel are ready to give him his next load. This has enabled the firm to save many minutes in the loading process at the hopper and to speed deliveries to customers.

A fourth signal—a "discussion call"—is used for emergencies. When terrain conditions are poor at a construction site, the first driver on the scene radios the dispatcher regarding the circumstances.

Occasionally, for example, a contractor needing ready-mixed concrete in a hurry might say by telephone that land conditions are good and yet the first ready-mix truck on the scene might bog down in soggy soil. In such cases, radio can provide the means by which the driver may alert other trucks not to enter the property, thus preventing them from being held up at the same time.

There are other instances where the "discussion call" results in more effective truck utilization. Frequently contractors place their orders the night before with instructions to "deliver, rain or shine." Arriving at the scene in the morning, however, the first driver finds that the contractor's men haven't shown up, or perhaps a crane isn't there to unload the concrete. By radio he informs the dispatcher to hold up on deliveries. As well as keeping vehicles from project sites when they aren't needed immediately, radio also serves to get deliveries there quickly when conditions warrant it. If a contractor wants to increase the size of his pour, radio helps him to do it.

Often, due to dependence on the work of sub-contractors, it is hard for a construction superintendent to estimate how much concrete he will need. Orders are usually on the conservative side. When a superintendent has forms completed for 30 cubic yards of material, he may order only 30. But if forming progresses to the point where there is need for 50 cubic yards, radio makes it possible to put in a quick order to the ready-mix plant for additional deliveries.

Radio communication has thus begun to establish itself as a dependable means by which the ready-mix producer can keep abreast of constant shifts in the contractor's activity. It provides the mobility the supplier needs in order to keep pace with the customer's requirements.

Photo by courtesy of Motorola

ABOVE: A typical base station at the truck-dispatching desk of a ready-mixed concrete firm. It keeps the dispatcher in close touch with delivery trucks and with job conditions and requirements. BELOW: No matter how far away from the plant in miles, truck-mixer drivers equipped with two-way radio units are never isolated.

"Time is vital in ready-mix operations," Mr. Clemente says. "Many thousands of dollars are lost by builders in overtime and idle-time costs when delivery service is below par. And equal amounts can be lost by ready-mix firms when trucks are needlessly bogged down by terrain problems."

These two "t" problems—time and terrain—can be overcome at least in part by mobile communications. Mr. Clemente and many other advocates of radio communication believe that radio is a boon not only to the ready-mix producer, but to the concrete construction man who is looking for ways to improve his operating efficiency. **END**

Do you use your employees for odd jobs?

SLACK PERIODS in the construction industry sometimes expose employers to a hazard which may not be any more likely to strike than a bolt of lightning, but which can be just as devastating if it hits. The slow season often creates the problem of what to do with men whom you don't want to lay off, but for whom you have a hard time finding something to do.

When this problem comes up you may remember that there are storm windows to put up at home. Or the gutters are full of leaves. Perhaps your summer home needs some work, or it is time to put your boat in dry-dock. This would be a good time to get that work done and let the company pay for it. One of your old, reliable employees is available, so you send him off to do your odd jobs.

Perhaps the ladder in your garage has a cracked rung, which you forgot to mention to him. He falls and breaks a leg, or worse. Perhaps you let him take a company car or truck. He has a blow-out, turns over, and is injured. Perhaps he is a good mechanic and you ask him to take a look at your balky hot water heater. It blows up in his face!

Now that old reliable employee has been injured while working for you. You're right! He wants to be compensated for his injuries. Then the bolt of lightning strikes. You're not insured! Your workman's compensation insurance probably covers employees only for the classifications specifically listed in the policy and only for work done in the course of your business. Or, even worse, perhaps under the circumstances his injury does not fall under the compensation act at all, so he can sue you at common law and get whatever a jury will give him.

The problem has unlimited variation. Perhaps the injury is compensable, but your policy doesn't cover it. Perhaps your workman's compensation insurance would cover the injury, but the employee has a choice of remedy and he decides to gamble on getting more by suing you instead of going before the compensation board.

Too many employers apparently believe that when they carry workman's compensation insurance their employees are automatically covered by insurance if they are injured while working. Instead, the test usually is whether the injured person's activity when he was injured was incidental to his regular employment, both under the language of the policy and under the compensation act. In other words, the employer might be liable, but he might not be insured. Most compensation acts state that the insurance policy "shall be deemed to include all employees of the employer employed at or in connection with the business of the employer carried on, maintained or operated at the location." Since premiums depend on classifications, it is only reasonable that the insurance company's liability is limited to those losses it had reason to believe its policy was supposed to cover. If liability were to exist regardless of the type of work actually done and the place at which it was done, the whole principle on which insurance is based would break down.

An example of how this odd job liability can arise is illustrated by an actual case. An officer of a building materials corporation sent one of the company truck drivers to help in transporting cattle from the officer's private farm to a stock show. An accident occurred and the man was killed. The court ruled that the compensation insurance policy, which covered the man while operating a truck on company business, did not cover the type of work he was doing when he was killed.

It is perhaps true that if you tried to cover yourself with insurance against every possible kind of accident your costs would be so high that you could never bid successfully for work. But with the gradual shortening of the construction industry's slack period, the tendency is to try to keep the men on the pay-roll. Letting them do odd jobs may be part of the answer, but it raises a serious question. How do you protect yourself in case they are injured? The answer can be provided by your insurance carrier and your attorney. They will want to be sure you are protected both in case of injuries compensable under your compensation law and those for which you may be personally liable for negligence. You can have endorsements added to your workman's compensation insurance policy, and you can buy personal liability insurance covering you against claims arising out of negligence. If you are aware of the problem, you can make your own decision as to how to solve it. END